

The documentation and process conversion measures necessary to comply with this revision shall be completed by 3 November 2003.

INCH-POUND

MIL-PRF-19500/168F
1 August 2003
SUPERSEDING
MIL-PRF-19500/168E
17 October 1998

PERFORMANCE SPECIFICATION

* SEMICONDUCTOR DEVICE, THYRISTORS (CONTROLLED RECTIFIERS), SILICON, TYPES 2N1771A, 2N1772A, 2N1774A, 2N1776A, 2N1777A, 2N1778A, 2N2619A, JAN, JANTX, AND JANTXV

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for PNP, silicon power, reverse-blocking triode thyristors. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to TO-64).

1.3 Maximum ratings.

Limits	I_O (1) $T_C = +105^\circ\text{C}$ (180° condition angle)	I_{TSM} (2)	V_{GM}	T_{op}	T_{STG}	d_v/d_t (3) (repetitive)
	<u>A</u>	<u>A</u>	<u>V(pk)</u>	<u>°C</u>	<u>°C</u>	<u>v/μs</u>
Min				-65	-65	5
Max	4.7	60	10	+150	+150	

- (1) This average forward current is for a maximum case temperature of +105°C, and 180 electrical degrees of conduction.
- (2) Surge rating is non-recurrent and applies only with device in the 'on' conducting state. The peak rate of surge current must not exceed 40 amperes/microsecond during the first 10 μs after switching from the "off" (blocking) state to the "on" (conducting) state. This time is measured from the point where the thyristor voltage has decayed to 90 percent of its initial blocking value.
- (3) $T_C = -65^\circ\text{C}$ to +150°C.

1.4 Primary electrical characteristics.

Limits	V_{TM}	I_H	V_{GT} (1)	I_{GT} (1)	t_{off} (1)	t_{on}
	<u>V</u>	<u>mA dc</u>	<u>V dc</u>	<u>mA dc</u>	<u>μs</u>	<u>μs</u>
Min			0.2			
Max	1.85	25	2.0	30	30	5

(1) $T_C = -65^\circ$ to +150°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

* 1.4.1 Individual ratings.

Types	V_{RRM}	V_{DRM}
	$V(pk)$ (1)	$V(pk)$
2N1771A	50	50
2N1772A	100	100
2N1774A	200	200
2N1776A	300	300
2N1777A	400	400
2N1778A	500	500
2N2619A	600	600

(1) Values apply for zero or negative gate voltage V_{GK} .

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

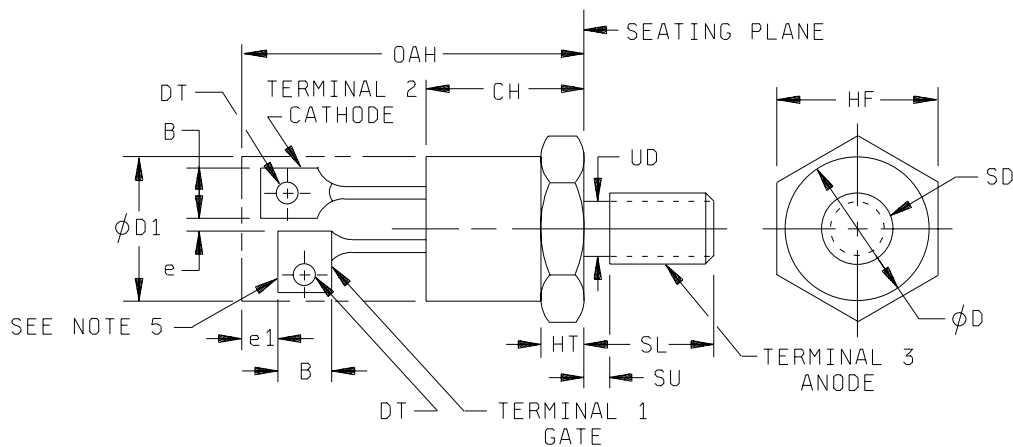
STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
B	.080	.136	2.03	3.45	3
CH	.300	.400	7.62	10.16	
DT	.040	.075	1.02	1.91	
e	.013		0.33		8
e ₁	.060		1.52		6
HF	.424	.437	10.77	11.10	
HT	.060	.175	1.52	4.45	4
OAH	.700	.855	17.78	21.72	2
ΦD	.400		10.16		9
ΦD ₁		.424		10.77	2
SD	.1658	.1697	4.212	4.310	7
SL	.400	.453	10.16	11.51	
SU		.078		1.98	
UD	.163	.189	4.14	4.80	

NOTES:

1. Dimensions are in inches. Metric equivalents are given for general information only.
2. Device contour except on hex head and noted terminal dimensions is optional within zone defined by ϕD_1 and OAH, ϕD_1 not to exceed actual HF.
3. Contour and angular orientation of terminals 1 and 2 with respect to hex portion and to each other are optional.
4. Chamfer or undercut on one or both ends of the hexagonal portion are optional.
5. Square or radius on end of terminal is optional.
6. Minimum difference in terminal lengths to establish datum line for numbering terminals.
7. Pitch diameter - thread 10-32 NF-2A (coated). See FED-STD-H28, "Screw-Thread Standards for Federal Services".
8. Minimum spacing between terminals.
9. Minimum diameter of seating plane.
10. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions (similar to TO-64).

3. REQUIREMENTS

3.1 General. The individual requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 herein.

3.4.1 Lead material and finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead material or finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 Construction. These devices shall be constructed in a manner and using materials which enable the thyristors to meet the applicable requirements of MIL-PRF-19500 and this document.

3.5 Marking. Devices shall be marked as specified in MIL-PRF-19500.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

* 4.3 Screening (JANTX and JANTXV levels). Screening shall be in accordance with appendix E, table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV, appendix E, of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
3a	Condition F, 10 cycles
7	Condition C or D for gross leaks
10	Not required
11	I_{RRM} , I_{DRM} V_{GT} , V_{TM}
12d	Method 1040 of MIL-STD-750, Condition A, $T_C = +145^\circ\text{C}$ minimum ; V_{RRM} , V_{DRM} = rated (see 1.4.1).
(1) 13	Subgroup 2 of table I herein, ΔI_{RRM1} = 100 percent of initial value or +1.0 mA(pk), whichever is greater. ΔI_{DRM1} = 100 percent of initial value or +1.0 mA(pk), whichever is greater.

(1) Devices which exceed the table I limits for this test shall be rejected.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of table I, subgroups 1 and 2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V of MIL-PRF-19500, and table I herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JANTX and JANTXV) of MIL-PRF-19500, appendix E, and as follows. Electrical measurements (end-points) shall be in accordance with the applicable steps of table II herein.

* 4.4.2.1 Group B inspection, appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition F, 15 cycles.
B2	1071	Condition C or D for gross leaks.
B2	4066	$I_{TSM} = 60 \text{ A(pk)}$ (0.5 sine wave); 10 surges 1 per minute; $I_O = 4.7 \text{ A}$ at rated. V_{RRM} ; $T_C = +65^\circ\text{C}$; $f = 60 \text{ Hz}$; surge duration = 7 ms, minimum.
B3	1026	$T_C = +118^\circ\text{C}, \pm 5^\circ\text{C}$, 50 min "on", $I_O = 1.25 \text{ A}$, T_C uncontrolled, 10 minutes "off".
B5		Not applicable.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with the applicable steps of table II herein.

* 4.4.3.1 Group C inspection, appendix E, table VII of MIL-PRF-19500

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition A, weight 10 pounds, application time = 15 seconds.
C2	1071	Condition C or D for gross leaks.
C3		Not applicable.
C6	1026	$T_C = +118^\circ\text{C}, \pm 5^\circ\text{C}$, 50 min "on", $I_O = 1.25 \text{ A}$, T_C uncontrolled, 10 minutes "off".

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

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* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Reverse blocking current	4211	AC method, bias condition D; $f = 60 \text{ Hz}$; $V_{RRM} = \text{rated}$ (see 1.4.1)	I_{RRM1}		1	mA(pk)
Forward blocking current	4206	AC method, bias condition D; $f = 60 \text{ Hz}$; $V_{DRM} = \text{rated}$ (see 1.4.1)	I_{DRM1}		1	mA(pk)
Gate trigger voltage and current	4221	$V_2 = V_D = 6 \text{ V dc}$; $T_C = +25^\circ\text{C}$ $R_e = 20 \Omega$ maximum	V_{GT1}		2	V dc
			I_{GT1}		15	mA dc
2N1771A, 2N1772A, 2N1774A, 2N1776A, * 2N1777A, 2N1778A * 2N2619A		$R_L = 50 \Omega$ $R_L = 50 \Omega$ $R_L = 50 \Omega$ $R_L = 50 \Omega$				
Forward "on" voltage	4226	$I_{TM} = 14.8 \text{ A(pk)}$ (pulse); pulse width = 8.5 ms; maximum; duty cycle = 2 percent maximum	V_{TM}		1.85	V(pk)
Holding current	4201	Bias condition D; $R_2 = 50 \Omega$ $V_{AA} = 24 \text{ V dc}$ maximum; $I_{F1} = 1 \text{ A dc}$; $I_{F2} = 100 \text{ mA dc}$; trigger voltage source = 6 V dc; trigger PW = 25 μs (minimum)	I_H		25	mA dc
Reverse gate current	4219	$V_G = 10 \text{ V dc}$	I_G		250	mA dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = +145^\circ\text{C}$				
Reverse blocking current	4211	AC method, bias condition D; $f = 60 \text{ Hz}$; $V_{RRM} = \text{rated}$ (see 1.4.1)	I_{RRM2}		2	mA(pk)
Forward blocking current	4206	AC method, bias condition D; $f = 60 \text{ Hz}$; $V_{DRM} = \text{rated}$ (see 1.4.1)	I_{DRM2}		2	mA(pk)
Gate trigger voltage and current	4221	$V_2 = \text{rated } V_{DM}$; $T_C = +125^\circ\text{C}$ $R_e = 20 \Omega$ maximum	V_{GT2}	0.2		V dc
2N1771A, 2N1772A 2N1774A, 2N1776A * 2N1777A, 2N1778A * 2N2619A		$R_L = 140 \Omega$ $R_L = 650 \Omega$				

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u> - Continued						
Low temperature operation:		$T_C = -65^{\circ}\text{C}$				
Reverse blocking current	4211	AC method, bias condition D; $f = 60\text{ Hz}$, $V_{RRM} = \text{rated}$ (see 1.4.1)	I_{RRM3}		1	mA(pk)
Forward blocking current	4206	AC method, bias condition D; $f = 60\text{ Hz}$; $V_{DRM} = \text{rated}$ (see 1.4.1)	I_{DRM3}		1	mA(pk)
Gate trigger voltage and current	4221	$V_2 = V_D = 6\text{ V dc}$; $R_e = 20\ \Omega$ maximum	V_{GT1}		2	V dc
			I_{GT2}		30	mA dc
2N1771A, 2N1772A		$R_L = 140\ \Omega$				
2N1774A, 2N1776A,		$R_L = 650\ \Omega$				
* 2N1777A, 2N1778A		$R_L = 650\ \Omega$				
* 2N2619A		$R_L = 650\ \Omega$				
<u>Subgroups 4 and 5</u>						
Not applicable						
<u>Subgroup 6</u>						
Exponential rate of voltage rise	4231	Bias condition D; $T_C = +150^{\circ}\text{C}$ repetition rate = 60 pps test duration = 15 s; $C = 10\ \mu\text{F}$; $50 \leq R_L \leq 400\ \Omega$	d_V / d_t		5	V/ μs
2N1771A		$V_A = 50\text{ V dc}$	V_D	47		V dc
2N1772A		$V_A = 100\text{ V dc}$		95		V dc
2N1774A		$V_A = 200\text{ V dc}$		190		V dc
2N1776A		$V_A = 300\text{ V dc}$		285		V dc
2N1777A		$V_A = 400\text{ V dc}$		380		V dc
* 2N1778A		$V_A = 500\text{ V dc}$		475		V dc
* 2N2619A		$V_A = 600\text{ V dc}$		570		V dc

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 7</u>						
Circuit commutated turn-off time	4224	$T_C = +145^\circ\text{C}$; $I_{TM} = 5 \text{ A pk}$; $t_{on} = 100 \mu\text{s}$; $d_i/d_t = 5 \text{ A}/\mu\text{s}$ minimum; reverse voltage at $t_1 = 2 \text{ V}$ minimum; repetition rate = 1 Hz ; $d_v/d_t = 5 \text{ V}/\mu\text{s}$; gate bias conditions: gate source voltage = 0 V ; gate source resistance = 100Ω	t_{off}			
2N1771A		$V_{DM} = V_{DRM} = 50 \text{ V(pk)}$; $V_{RRM} = 50 \text{ V}$ maximum			30	μs
2N1772A		$V_{DM} = V_{DRM} = 100 \text{ V(pk)}$; $V_{RRM} = 100 \text{ V}$ maximum			30	μs
2N1774A		$V_{DM} = V_{DRM} = 200 \text{ V(pk)}$; $V_{RRM} = 200 \text{ V}$ maximum			30	μs
2N1776A		$V_{DM} = V_{DRM} = 300 \text{ V(pk)}$; $V_{RRM} = 300 \text{ V}$ maximum			30	μs
2N1777A		$V_{DM} = V_{DRM} = 400 \text{ V(pk)}$; $V_{RRM} = 400 \text{ V}$ maximum			30	μs
* 2N1778A		$V_{DM} = V_{DRM} = 500 \text{ V(pk)}$; $V_{RRM} = 500 \text{ V}$ maximum			30	μs
* 2N2619A		$V_{DM} = V_{DRM} = 600 \text{ V(pk)}$; $V_{RRM} = 600 \text{ V}$ maximum			30	μs
Gate controlled turn-on time	4223	$I_{TM} = 5 \text{ A dc}$; $V_{GG} = 10 \text{ V dc}$; $R_e = 50 \Omega$; $t_{p1} = 15 \pm 5 \mu\text{s}$; $2 \text{ A}/\mu\text{s} \leq d_i/d_t \leq 200 \text{ A}/\mu\text{s}$	t_{on}		5	μs
2N1771A		$V_A = V_{DRM} = 50 \text{ V(pk)}$				
2N1772A		$V_A = V_{DRM} = 100 \text{ V(pk)}$				
2N1774A		$V_A = V_{DRM} = 200 \text{ V(pk)}$				
2N1776A		$V_A = V_{DRM} = 300 \text{ V(pk)}$				
2N1777A		$V_A = V_{DRM} = 400 \text{ V(pk)}$				
* 2N1778A		$V_A = V_{DRM} = 500 \text{ V(pk)}$				
* 2N2619A		$V_A = V_{DRM} = 600 \text{ V(pk)}$				

1/ For sampling plan, see MIL-PRF-19500.

TABLE II. Groups A, B, and C electrical end-point inspection measurements. 1/ 2/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Reverse blocking cutoff current	4211	AC method, bias condition D; $f = 60 \text{ Hz}$; $V_{RRM} = \text{rated}$ (see 1.4.1)	I_{RRM1}		1	mA(pk)
2.	Forward blocking current	4206	AC method, bias condition D; $f = 60 \text{ Hz}$; $V_{DRM} = \text{rated}$ (see 1.4.1)	I_{DRM1}		1	mA(pk)
3.	Reverse blocking cutoff current	4211	AC method, bias condition D; $T_C = +125^\circ\text{C}$; $f = 60 \text{ Hz}$; $V_{RRM} = \text{rated}$ (see 1.4.1)	I_{RRM2}		2	mA(pk)
4.	Forward blocking current	4206	AC method; bias condition D; $T_C = +125^\circ\text{C}$; $f = 60 \text{ Hz}$; $V_{DRM} = \text{rated}$ (see 1.4.1)	I_{DRM2}		2	mA(pk)
5.	Gate trigger voltage and current	4221	$V_2 = V_D = 6 \text{ V dc}$; $R_L = 50 \Omega$; $R_e = 20\Omega$ maximum	V_{GT1} I_{GT1}		2 15	V dc mA dc
6.	Forward "on" voltage transfer ratio	4226	$I_{TM} = 14.8 \text{ A(pk)}$ (pulse); pulse width = 8.5 ms maximum; duty cycle = 2 percent maximum	V_{TM}		1.85	V(pk)

1/ The electrical measurements for appendix E, table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500 are as follows: Subgroups 2, 3, and 6, see table II herein, steps 1, 2, 3, 4, 5, and 6.

2/ The electrical measurements for appendix E, table VII of MIL-PRF-19500 are as follows:
Subgroups 2, 3, and 6, see table II herein, steps 1, 2, 3, 4, 5, and 6.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. The lead finish or material as specified (see 3.4.1).
- d. Type designation and quality assurance level.
- e. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List (QML-19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, ATTN: DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2751)

Review activities:
Army - AV, MI
Air Force - 19, 99

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1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-19500/168F

2. DOCUMENT DATE
1 August 2003

*3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, THYRISTORS (CONTROLLED RECTIFIERS), SILICON, TYPES 2N1771A, 2N1772A, 2N1774A, 2N1776A, 2N1777A, 2N1778A, 2N2619A, JAN, JANTX, AND JANTXV

4. **NATURE OF CHANGE** (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. **REASON FOR RECOMMENDATION**

6. SUBMITTER

a. NAME (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

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8. PREPARING ACTIVITY

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